

What Is Claimed Is:

1. A probe card assembly for testing a device comprising:  
a substrate with probe contacts on a first surface;  
a probe card to electrically connect said probe contacts to a test system;  
an electrical connection means to connect the probe contacts to the probe card; and  
support means positioned against a second surface of the substrate substantially opposite  
said probe contacts to transmit probe forces introduced when the probe contacts are urged against  
corresponding contacts on the device being tested.
2. The probe card assembly of claim 1, wherein the substrate comprises a ceramic material.
3. The probe card assembly of claim 1, wherein the substrate comprises an organic material.
4. The probe card assembly of claim 1, wherein the support means comprises a screw  
element.
5. The probe card assembly of claim 1, wherein the support means comprises an elastomer  
pad.
6. The probe card assembly of claim 1, wherein the support means comprises a gimble.
7. The probe card assembly of claim 1, wherein the support means comprises a rigid support  
member attached to the substrate opposite the probe contacts.

8. The probe card assembly of claim 1, wherein the support means comprises a gimble removably contacting a rigid support member attached to the substrate.

9. The probe card assembly of claim 1, wherein the electrical connection means comprises an interposer.

10. The probe card assembly of claim 1, wherein the electrical connection means comprises pogo pins.

11. The probe card assembly of claim 1, further comprising:

a frame provided around a peripheral edge of the substrate, the frame including a horizontal extension extending over the surface of the substrate, wherein the probe forces are transmitted by the support means to the frame.

12. The probe card assembly of claim 11, wherein the horizontal extension of the frame includes a load support member extending vertically from a surface of the horizontal extension to engage the first surface of the substrate in an area separated from the peripheral edge of the substrate.

13. The probe card assembly of claim 11, further comprising:

a first membrane provided between a surface of the horizontal extension of the frame and the first substrate surface; and

a second membrane provided between the first membrane and the substrate to engage the substrate in an area separated from the peripheral edge of the substrate.

14. The probe card assembly of claim 11, wherein the probe card comprises:

a printed circuit board (PCB) having connectors to connect with a test head on a first side, and electrical connection pads on an opposing second side for connecting to the electrical connection means, the probe card assembly further comprising;

a bracket fixedly attached to the second side of the PCB, the bracket being provided around the peripheral edge of the frame; and

leaf springs having a first end attached to the bracket, and a second end contacting the frame so that the force applied by the leaf springs and support means support the substrate within the frame.

15. The probe card assembly of claim 8, wherein the probe card comprises:

a printed circuit board (PCB) having connectors to connect to the test head on a first side, and electrical connection pads on an opposing side, the PCB including an opening through which the screw element passes; and

an interposer having electrically conductive spring contacts on each side to connect the pads of the PCB to the electrical contacts on the second surface of the substrate, the interposer including an opening through which the screw element passes.

16. The probe card assembly of claim 1, wherein the substrate comprises:

a first substrate layer having probe contacts on a first surface, the first substrate comprising a first material; and

a second substrate attached to a second surface of the first substrate, the second substrate including routing lines electrically connecting the probe contacts, the routing lines further providing connections to connect to the probe card, the second substrate comprising a second material having a lower flexural strength than the first material.

17. A probe card assembly for testing a device comprising:

a substrate with probe contacts on a first side, and an array of electrical contacts on a second side of the substrate opposite the first side, the electrical contacts connected to the probe contacts; and

a support removably contacting the second side of the substrate within an area substantially surrounded by the array of electrical contacts.

18. The probe card assembly of claim 17, wherein the support comprises a pin contacting a gimble, the gimble contacting the second side of the substrate.

19. The probe card assembly of claim 17, wherein the support comprises a pin contacting a gimble against a metal plate, the metal plate contacting an elastomer pad, the elastomer pad contacting discrete elements attached to the substrate.

20. The probe card assembly of claim 17, wherein the support comprises a pin supporting an elastomer pad against the substrate.

21. The probe card assembly of claim 20, wherein the pin supports a gimble contacting a metal plate attached to the elastomer pad.
22. The probe card assembly of claim 17, wherein the support comprises a pin contacting a gimble against a rigid support member attached to the second side of the substrate.
23. The probe card assembly of claim 22, wherein the rigid support member has openings provided for discrete electrical elements attached to the second side of the substrate.
24. The probe card assembly of claim 23, wherein the discrete electrical elements comprise isolation capacitors.
25. The probe card assembly of claim 17, wherein the support further contacts the substrate outside of the array of electrical contacts, the support comprising:
- a backplate movably connected to the substrate;
  - spheres, including first spheres to contact near edges of the substrate, and at least one second sphere to contact near a center of the substrate; and
  - pins screwed through the backplate, each of the pins positioned to engage one of the spheres to enable leveling of the first surface of the substrate.
26. A probe card assembly for testing a wafer comprising:
- a substrate having a surface supporting probe contacts; and

a frame provided around a peripheral edge of the substrate, the frame including a horizontal extension extending over the surface of the substrate supporting the probe contacts, the horizontal extension comprising a load support member extending vertically from a surface of the horizontal extension to engage the surface of the substrate supporting the probe contacts in an area separated from the peripheral edge of the substrate.

27. The probe card assembly of claim 26, wherein the load support member is machined into the frame.

28. The probe card assembly of claim 26, wherein the load support member comprises a flexible membrane.

29. A probe card assembly of claim 28, wherein the flexible membrane comprises:  
a first membrane provided between a surface of the horizontal extension of the frame and the substrate surface; and

a second membrane provided between the first membrane and the substrate to engage the surface of the substrate supporting the probe contacts in the area separated from the peripheral edge of the substrate.

30. The probe card assembly of claim 29, wherein the first membrane and the second membrane comprise an electrically insulating material.

31. A probe card assembly of claim 26, wherein the horizontal extension extends over an area comprising 70% or more of the surface of the substrate supporting the probe contacts.

32. A probe card assembly for testing a wafer comprising:

a substrate having a first surface supporting probe contacts and a second surface having a land grid array (LGA) of electrical connection pads;

a printed circuit board (PCB) having connectors for connecting to a test head on one side, and electrical connections provided on a second side for connecting to the pads of the LGA;

an bracket fixedly connected to the PCB;

a frame provided around a peripheral edge of the substrate, the frame including a horizontal extension extending over the first surface of the substrate; and

leaf springs having a first end attached to the bracket, and a second end to engage a surface of the frame, the leaf springs including bends between the first end and the second end to enable the peripheral edge of the frame to extend vertically from the bracket.

33. The probe card assembly of claim 32, wherein the first end of the leaf springs are attached by screws and the bends between the first end and the second end of the leaf springs prevent the screw heads from extending vertically past the probe contacts.

34. The probe card assembly of claim 32 further comprising:

an interposer having electrically conductive spring contacts on each side to connect the pads of the PCB to the pads of the LGA of the substrate.

35. A method for determining an optimum contact area between a frame and a substrate containing probe contacts, the probe contacts for contacting a wafer to test integrated circuits on the wafer, the method comprising:

providing different membranes on a horizontal extension of the frame between the horizontal extension and a surface of the substrate containing the probe contacts, wherein the different membranes each contact the substrate in a different area; and

determining flexibility of the substrate with each membrane to enable selection of one of the membranes allowing minimal flexing of the substrate.

36. A probe card assembly for testing a device comprising:

a first substrate with probe contacts on a first surface, the first substrate comprising a first material; and

a second substrate attached to a second surface of the first substrate, the second substrate including routing lines electrically connecting to the probe contacts, the routing lines further providing connections to a test system, the second substrate comprising a second material different than the first material.

37. The probe card assembly of claim 36, wherein the first material is more rigid than the second material.



38. The probe card assembly of claim 36, wherein the first substrate comprises a high temperature co-fired ceramic material, and the second substrate comprises a low temperature co-fired ceramic material.

39. The probe card assembly of claim 36, wherein the first substrate is a high temperature co-fired ceramic material, and the second substrate is an organic material.

40. The probe card assembly of claim 36, wherein the first substrate includes straight feed through vias connecting the probe contacts to the routing lines of the second substrate.

41. The probe card assembly of claim 36, wherein the second substrate is attached to the first substrate by solder joints that further serve to electrically connect the vias of the first substrate to the routing lines of the second substrate.

42. The probe card assembly of claim 36 wafer comprising:

a printed circuit board (PCB) having connectors for connecting to a test head on one side, and electrical connections provided on a second side for connecting to the routing lines of the second substrate;

an bracket fixedly connected to the PCB;

a frame provided around a peripheral edge of the second substrate, the frame including a horizontal extension extending over the first surface of the second substrate; and

leaf springs having a first end attached to the bracket, and a second end to engage a surface of the frame.

43. A probe card assembly of claim 42, wherein the horizontal extension comprises a load support member extending vertically from a surface of the horizontal extension to engage the surface of the second substrate supporting the probe contacts in an area separated from the peripheral edge of the second substrate.

44. The probe card assembly of claim 43, wherein the load support member is machined into the frame.

45. The probe card assembly of claim 43, wherein the load support member comprises a flexible membrane.

46. The probe card assembly of claim 42, wherein the leaf springs include bends between the first end and the second end to enable the peripheral edge of the frame to extend vertically from the bracket.

47. The probe card assembly of claim 42, further comprising:  
an interposer having electrically conductive spring contacts on each side to connect the routing lines of the second substrate to pads of the PCB.

48. A probe card assembly for testing a device comprising:  
a first substrate with probe contacts on a first surface, and straight through vias connecting the probe contacts to a second surface opposite to the first surface; and

a second substrate attached to a second surface of the first substrate, the second substrate including routing lines electrically connecting to the vias, the routing providing both horizontal and vertical routing within the second substrate to provide connections to a test system.

49. The probe card assembly of claim 48, wherein the second substrate is attached to the first substrate by solder joints that further serve to electrically connect the vias of the first substrate to the routing lines of the second substrate.